Photorealistic Facial Reconstruction of Ramses II for Virtual Sets (sap_0040)

Makoto Danjo¹  Yuko Masunaga¹  Ayako Tateishi¹  Hiroko Uchiyama¹  Hiraku Kasahara²
Sakuji Yoshimura³  Kazuaki Hirata³  Tomohito Nagaoka⁵  Masa Inakage⁶
¹Joshibi University of Art and Design, Kanagawa, Japan. ²Tokyo Broadcasting System Television, INC. Tokyo, Japan.
³Cyber University, Fukuoka, Japan. ⁴Waseda University, Tokyo, Japan. ⁵St. Marianna University School of Medicine, Kanagawa, Japan. ⁶Keio University, Kanagawa, Japan.

1. Introduction
This paper presents a facial reconstruction and photorealistic visualization technique of the ancient Egyptian Pharaoh Ramses II. G. Attardi et al. [1] have reconstructed a three dimensional computer graphics facial model from computerized tomography data. K.Kahler et al. [2] have successfully visualized a facial expression model made from facial expression muscles. We obtained x-ray photographs capturing the cranial bones of Ramses II from Professor Faure, who headed the x-ray photography of Ramses II. Our facial reconstruction process is based on the x-ray photographs. In addition, we have made photorealistic visualization of Ramses II using subsurface scattering technique to capture the complex reflection model of the skin. Furthermore, we used the rendering results in Virtual Sets of a television program.

2. Facial Reconstruction Process
2-1. Cranial Bone Creation
We reconstructed a cranial bone based on 3 x-ray photographs of the mummy of Ramses II taken in 1976, which were representing the front, side, and top views.

2-2. Basic Model
In order to model the basic face, we added cranial landmarks on the cranial bone, from anatomical viewpoint as illustrated in Figure 2. By the definition of Rudolf Martin [3], cranial landmarks are essential as a base point for facial reconstruction. Based on cranial landmarks, we added the skin layer to create the basic face model using Helmer’s average facial tissue measurements [4].

2-3. Soft Tissue
In determining soft tissue elements such as the nose, lips, and ears, several factors such as the race, gender, age, and historical background of Ramses II must be considered. First, looking at the issue from an Egyptology point of view, it is believed that Ramses II was a Mediterranean from the north of Egypt. Second, many characteristics of the soft tissue of Ramses II can be inferred from his mummy.

3. Photorealistic Visualization
In order to visually simulate the skin, reflectance model plays an important role. The photorealistic visualization of skin can be attained by using the subsurface scattering technique. This paper takes into consideration that skin coloration also differs for different areas on the face. Instead of using a simple single color facial coloration, we have created a range table of hue, color saturation, and luminosity, by referencing skin sample photographs of Egyptians under multiple environments.

We used the “missss_fast_skin” shader, which is a simplified subsurface scattering shader provided for the Metal Ray rendering software. To control the thickness and coloration of each layer of the “epidermis,” “dermis,” and “hypodermis”, parameters of Weight, Radius, and Depth in “missss_fast_skin” shader were carefully adjusted.

Figure 3 shows the photorealistic rendered result of Ramses II, and its rendering time was 9 minutes at a resolution of 1920 x 1080 pixels in an IntelXeon3.2GhzDual, 1.0GB memory system.

4. Application to Virtual Sets for TV Program
Subsurface scattering technique is not available in the virtual sets system Brainstorm eStudio, therefore we have adopted a texturing approach to create the same rendering quality in the virtual sets. The texture is created in the following 3 steps:

(1) The Ramses II facial model is rendered using parallel projection from the front, left, right, and top views.
(2) These rendered images are re-rendered with Projection Mapping to convert into 4 UV texture map images.
(3) The 4 UV texture map images are composited and retouched to create 1 color texture map image.

Figure 4 shows a still frame from the television program which used virtual sets.

Figure 3: Photorealistic rendering of Ramses II

Figure 4: Still frame from the television program

Image courtesy of Tokyo Broadcasting System, Inc.

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References

Figure 1: Cranial landmarks  Figure 2: Basic skin surface

Figure 2: Basic skin surface